Report on the Mission at FELCRA/MALAYSIA

from 12th to 26th February 1992

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WORLD BANK / IFC / MIGA

OFFICE MEMORANDUM

DATE: February 6, 1992

TO: Mr. J.M. Eschbach, Consultant

FROM: D.M. Dowsett-Coirolo, Chief, EA1AG

EXTENSION: 81344

SUBJECT: MALAYSIA: Second FELCRA Land Development Project (Ln.2917-MA)
Evaluation of Labor Saving Rubber Exploitation Technology
Terms of Reference

1. You will arrive in Kuala Lumpur, Malaysia on or about February 11, 1992 for a period of two weeks until February 26 to review and evaluate with the Federal Land Consolidation and Rehabilitation Authority (FELCRA), the progress and results of the demonstration trials of reduced frequency tapping systems established in the second half of 1991. While in Malaysia, you will visit all nine demonstration sites of the new technology and also the large area pilot trial at Bukit Pedoman estate. Your work program will be coordinated with FELCRA management who will be responsible for making all arrangements for the field trips.

2. In your work, you will:

(i) examine the content, timing and quality of implementation of the technology at each site for consistency with the protocols and statistical validity, review the accuracy of data recording and reporting and advise any required changes. Special attention should be given to the monitoring of bark consumption.

(ii) customize as necessary an appropriate computerized analysis procedure of trial data for use by FELCRA, summarize and review the interim results of each trial and indicate how these are consistent or otherwise with expected results,

(iii) from overall results of the trials to date, draw interim conclusions on the applicability of reduced frequency tapping to FELCRA's conditions and indicate broad economic benefits from its use.

(iv) confirm timetable for the continuation of these trials and advise to the Bank your proposals for the expansion of the technology in FELCRA schemes taking into account both FELCRA's needs and capacity.

3. Review with FELCRA problems and applicability of the current tapping wage structure for use in reduced frequency tapping and suggest modifications which FELCRA could consider to ensure economy in tapping costs and an attractive, incentive-oriented system for tappers.

4. On your return to France, you will prepare a report on mission findings and recommendations on reduced frequency tapping systems in FELCRA schemes and submit the report to the Bank by mid-March.

Mission Schedule

12th February 1992:	Arrival in Kuala Lumpur
13th February 1992:	Mission programme and courtesy calls
14th February 1992:	Data update and visit preparation
15th February 1992:	ULU ROKAN and ULU YOH estates (NEGERI SEMBILAN)
16th February 1992:	Flight for ALO SETAR, HULU PAUH estate (PERLIS)
17th February 1992:	BUKIT TAMPOI I and II and PULAU BELANTIK estates (KEDAH)
18th February 1992:	BENDANG MAN estate, ferry to Langkawi Island
19th February 1992:	SELAT BAGAN NYIOR and KAMPONG KOK estates, flight for Kuala Lumpur
20th February 1992:	PESAGI and BATU EMPAT-PAYA LUAS estates
22nd February 1992:	Flight for JB (JOHOR) BUKIT KEREMOYIANG estate, TEBING TINGGI
23rd February 1992:	BUKIT PEDOMAN and KAMPUNG AWAT I and II estates
24th February 1992:	MAWAI BARU estate, flight for Kuala Lumpur
25th February 1992:	Kuala Lumpur
26th February 1992:	Kuala Lumpur

1. Implementation of demonstration trials (DT)

1.1. Setting up

Three DTs were set up late due to tapper availability problems: Ulu Rokan, Bukit Pedoman III and Bukit Keremoyiang were launched in September, whereas the other trials were launched in July or at the beginning of August. Hence, for the latter trials, 6 months' results were available at the beginning of February.

All the plots (111 tapping tasks) corresponding to the different treatments and replicates were marked out and tapped in accordance with the frequency set down in the protocol. The plot layout in the field does not always tally with the protocol layout, due to rearrangement of the tapping tasks, but in the majority of cases, it is possible to divide up the plot arrangement into uniform blocks in the field, for statistical analysis of results.

In the Bukit Tampoi II trial, treatments 3 and 4 with upward tapping were started late due to a lack of qualified tappers. The results obtained on some tappings will not be taken into account.

In the Bukit Keremoyiang trial, a certain number of trees in the 1/2 S tapping plots are tapped in upward 1/4 S (dry trees or presumed to be dry on the lower panel). The trees should be returned to downward 1/2 S or halted and stripped of their equipment.

1.2. Tapping

Tapping quality varies greatly and is somewhat mediocre. Wounds, to which wound dressings are never applied, are particularly numerous when the cut is on regenerated bark (DT Nos. 6 to 9). Attention is drawn to the fact that stimulant application to wounded wood (sometimes more than 50% of the bark area) may harm the tree.

However, the most important point is bark consumption, -which, in the majority of cases, proves to be greatly in excess of accepted norms, which themselves are higher than in the theoretical norms set out in the protocol.

Tapping frequency	Tappings/ year	Accepted norms		Theoretical norms	
		cm/yr	mm/tapping	mm/tapping	cm/yr
d/2	150	25	1.7	1.5	23
d/3	100	18	1.8	1.6	16
d/4	75	14	1.8	1.7	13
1/4 S				2.0	15 to 20

It is necessary to be able to measure and keep track of bark consumption. Marks daubed in white paint corresponding to monthly consumption are not suitable because:

1. a difference of 2.3 centimetres for the month corresponds to 13 tappings for 26 working days, a number which is never reached, especially in the rainy season.

2. a substantial increase in the cut slope makes it impossible to identify the corresponding monthly paint mark.

Hence, to help the tapper keep track of consumption, it is recommended:

- on virgin bark (DT Nos. 1 to 5): to trace out a consumption guide on each panel using a template, corresponding to quarterly consumption, as provided for in the protocol.

- on regenerated bark (DT Nos. 6 to 9): to mark the top, middle and bottom of the cut with white paint (as seen in the trial: a circle for the month and a 2-cm stroke for the quarter).

On the panel that has just been consumed, a dot of paint of a different colour at the beginning of April will make it possible to measure bark consumption from a known date.

The tapping and tapping supervisor training programme has been highly beneficial and the results are clear in certain DTs.

1.3. Stimulation

As no stimulation was scheduled during the month of the visit, application demonstrations were organized. The concentration and quantities were in accordance with the protocols. However, it is recommended that the stimulant be applied over a width of 1 cm on the regenerated panel above the cut, without trying to apply it to tree lace. Brush size No. 10 is appropriate. It is best to apply the stimulant the day after tapping, and not the same day.

In high rainfall periods, it is preferable to stimulate trees, even if the number of tappings is substantially reduced. In this respect, the norms applied to tappings not carried out due to rainfall seem to be particularly strict. A damp panel should not jeopardize tapping, even though there are slight latex losses.

1.4. Result recording

Latex and cup lump weighing poses no problems. However, cup lumps should not be left on the ground at the foot of trees during low production periods. It is recommended that they be grouped together on a plastic sheet in a specific place in the plot. On the record slip, the cup lumps of the previous tapping(s) are recorded.

New monthly record slips have been distributed to each DT and from now on they should be used to indicate the dates of stimulation operations and the true rainfall data. The Ulu Rokan and Ulu Jenut plantations should be equipped with a rainfall meter. In the meantime, rainfall data from neighbouring weather stations should be indicated.

2. Provisional Results

Pending calculations regarding g/tree (kg/ha/year) and g/tree/tapping (kg/tapper), an initial set of calculations has been produced for kg/plot. It is taken that the number of trees differs little according to tapping task.

With stimulated reduced tapping, the aim is to obtain at least 100% of 1/2 S d/2 production. Figures 1 and 2 sum up the results obtained on the 9 DTs, along with cumulated data per plot and per DT, and the monthly changes in treatments shown in the annex.

Tables 1 and 2 sum up the characteristics of the DTs and figure 3 indicates their location.

2.1. Bendang Man

The results are satisfactory, since d/2 production is obtained in d/3 6/y or d/4 6/y with only 3 stimulations, as opposed to the 4 planned for the period. Treatment d/3 4/y produced 88% of d/2 with 1 stimulation rather than with the two planned: October was particularly wet.

Tapping quality is good, both as regards depth (no wounds) and consumption.

2.2. Ulu Rokan

It is on this estate that the results are the poorest, as the production obtained in d/4 is significantly lower than that obtained with d/2 (66%). However, the trees were only stimulated twice rather than the planned three times and the trial only began in September. It will take longer before any conclusions can be drawn.

Tapping quality is mediocre and it is recommended not to tap so deep and to reduce bark consumption.

2.3. Ulu Jenut

Tapping yields in d/3 are highly satisfactory (equal to or greater than with d/2). The yields with d/4 are lower, though not significantly so.

There are few wounds, but bark consumption is too high, especially where reduced frequency applies.

2.4. Bukit Pedoman III

Stimulated reduced tapping gives the same production as tapping in d/2, with only 1 or 2 stimulations rather than the 2 or 3 planned.

Bark consumption is satisfactory, but panel wounds are numerous.

Total production is low because the trees were opened late (16th September) and rainfall in November and December was particularly high (over 2,000 mm in two months).

2.5. Bukit Pedoman I

On trees already opened for 6 years (panel B, virgin bark), stimulated d/4 tapping gives production 28% lower than d/2. The difference lies on the verge of significance.

Tapping quality is mediocre. Closer supervision is required in this trial: tapping and production collection.

2.6. Ulu Pauh

On regenerated bark the results of this DT are very satisfactory (+25% in d/3 and +18% in d/4). Stimulation was carried out correctly on the right dates.

Upward 1/4 S d/3 tapping is particularly productive and the results over 1 year will no doubt make it possible to consider tapping in d/4.

In reality, tapping quality is average but upward 1/4S consumption was 25 cm as opposed to the planned 10 cm, i.e. more than twice the norm.

2.7. Bukit Tempoi I

The response to tapping in d/4 is very low and significantly less than that of the control (52%). However, the correct number of stimulations were carried out.

Tapping quality is mediocre, especially on upward 1/4S, with consumption three times higher than the norm (30 cm in 6 months). Upward tapping has not been completely mastered, which might explain the low production obtained.

2.8. Bukit Tampoi II

Unlike the previous trial, the tapping results in d/4 are highly satisfactory; production is significantly higher than that of the control (+29%). GT1 responds well to d/4 tapping on regenerated bark.

Upward tapping was begun too late for interpretable results. Wounds are numerous but bark consumption is satisfactory.

2.9. Bukit Keremoyiang

On RRIM 600 the d/4 results (78% of d/2) are not as good as on GT 1, but the difference compared to the d/2 control is not significant. Upward tapping gives good production, even in d/4, which seems to be the best frequency given bark consumption which, in these plots, is double the norm.

With downward tapping, bark consumption is satisfactory. However, particular attention should be paid to tapping quality: many wounds (especially in task No. 57 where the tapper ought to be changed) and untapped trees.

2.10. Bukit Pedoman III

It was planned to open this plantation in June 1991 in 1/2S d/3 ET 2.5% 0.7(1) 4/y. The shortage of tappers delayed opening until January 1992. The bark consumption and production obtained are very satisfactory, even in the absence of stimulation (defoliation period).

3. Applicability of reduced frequency tapping

Bearing in mind:

- the initial provisional results obtained in the DTs,
- previous results obtained by RRIM in Malaysia,
- the results obtained in Africa with reduced frequency tapping and stimulation since opening.

In cases where there are manpower shortages, the following recommendations can be made:

- opening trees, or tapping on virgin bark, in d/3 with 4 stimulations/year:

  1/2S d/3 6d/7 ET 2.5% 0.7 () 4-6/y

- tapping on regenerated bark in d/3 or d/4:

  1/2S d/3 6d/7 ET 2.5% 1 (1) 8/y
  1/2S d/4 6d/7 ET 2.5% 1 (1) 10/y

And in cases where there are many dry trees, tapping in upward 1/4S d/4, alternated with downward 1/2S

  1/4S ↗ d/4 6d/7 ET 5% 1 (1) 12/y

N.B. It is essential that this reduction in tapping intensity be accompanied by an improvement in tapping quality and wound treatment.

The reduction in tapping costs per hectare should make it possible to introduce incentive bonuses for tapping quality.

4. Continuation of the Project

4.1. Trials under way

The response to stimulation and reduced tapping frequency greatly depends on climatic and phenotypical conditions and must therefore be observed over a minimum of a year. In order to confirm the results in the medium term, a second year of observations is necessary.

In order to eliminate any tapper effect, it is recommended that a tapping task rotation system be introduced after 1 year of trials, i.e. in July 1992, or that tappers be changed (see example below):

Treatment	Tapper 1991–1992	Tapper 1992–1993
1. Green	a	c or f
1. Green	b	d or g
2. Black	c	e or h
3. Yellow	d	a or i
4. Red	e	b or j

In DTs 1 to 4, tree recuperation will take place 6 to 12 months after opening (March to July). It is preferable not to proceed with new tapping task distribution.

A new stimulation schedule has been drawn up, taking climatic constraints into account (Table 3). It is necessary that a gap of at least 3 weeks be respected between two stimulations. Upward 1/4S tappings in d/4 on DTs 8 and 9 should only be stimulated 10 times a year.

4.2. Pilot plantations

It is proposed that reduced frequency tapping be introduced on ten or so plantations seen and selected during our visit. Each of them corresponds to a given age, clone and zone, for which manpower availability problems have arisen.

Table 4 sums up the characteristics of these plantations and figure 4 their location.

4.2.1. ULU PAUH

As there are only 75 tappers for 187 tapping tasks and given the results obtained in the DTs, a change can be made to 90 tasks in 1/2S d/3 6d/7 ET 2.5% 1(1) 8/y, which would make it possible to tap a further 15 tasks.

4.2.2. PULAU BELANTIK I

The shortage of tappers on site means that they have to be brought in from 50 km away. Changing to 1/2S d/3 ET 2.5% 8/y on the 436 ha would make it possible to reduce the number of tappers required from 135 to 90.

4.2.3. KAMPONG KOK

With a reduction in the number of tappers from 52 to 27 for 81 tapping tasks, a frequency of d/3 ET 2.5% 1(1) 6/y will have to be introduced throughout the 107 ha. The plantation was stimulated on 15/10/91 with 1.25% Ethrel and is properly supervised.

4.2.4. PESAGI I, II and III

Plantations I and II, set up from 1983 to 1985, have yet to be opened due to a shortage of tappers; at PESAGI II, tappable tree density is 470/ha for 495 existing trees/ha. It is recommended that each of the plantations be tapped using a different system: d/2, d/3 and d/4, so as to compare the yields obtained with these three tapping systems on a commercial scale, under identical environmental conditions, and with largely equivalent clonal distribution.

PESAGI I d/4 ET 2.5% 0.7(1) 6/y (cf ULU JENUT)
PESAGI II d/3 ET 2.5% 0.7(1) 6/y
PESAGI III d/2 unstimulated.

4.2.5. BATU EMPAT

At this plantation, with tapping on regenerated bark, a switch to d/4 would make it possible to tap virtually the entire area planted with the available number of tappers (120 tasks instead of 147).

1/2S d/4 ET 2.5% 1(1) 10/y.

4.2.6. PAYA LUAS

Given the high number of dry trees, it is advised initially to tap in upward 1/4S d/4 ET 2.5% 1(1) 10/y with 5 tappers (20 tapping tasks) in the most affected tasks.

The remainder of the plantation (84 tasks) will be tapped in 1/2S d/3 ET 2.5% 1(1) 10/y.

4.2.7. ULU YOH

With 60 tappers for 180 tapping tasks, this plantation will be opened in d/3 with 4 stimulations per year (cf ULU ROKAN).

1/2S d/3 ET 2.5% 0.7(1) 4/y

4.2.8. KAMPUNG AWAT

Despite 35% of untapped tasks (12% due to tapper shortages and 23% to rain), trees in the third year of tapping give satisfactory yields (820 kg/ha in 1991). It is possible to compare d/2 and d/3 on a commercial scale by splitting the plantation into 5 blocks, A, B, C, D and E, with 32 tasks each. Blocks A, C and E should be tapped in 1/2S d/3 ET 2.5% Pa 0.8(1) 6/Y and blocks B and D in unstimulated d/2, i.e. 72 tappers for 180 tasks.

Tapping quality is good, wounds are tended, but consumption is too high.

4.2.9. TEBING TINGGI I, II and V

On these plantations, 14 to 44% of the tasks have been lost due to manpower shortages.

The following is proposed:

I : 1/2S d/4 ET 2.5% Pa 1(1) 6/y
II and V : 1/2S d/3 ET 2.5% Pa 0.8(1) 6/y

4.2.10. MAWAI BARU

There are no longer enough tappers to tap the entire area and it is recommended that 126 tasks be tapped in d/3 stimulated 10 times/year (cuts are on regenerated bark) 1/2S d/3 6d/7 ET 2.5% Pa 1(1) 10/y and, as an experiment, 20 tasks in 1/4S ↗ d/4 ET 5% Pa 1(1) 10/y.

4.2.11. BUKIT PEDOMAN III

This plantation was opened in January 1992 in d/3 and will be stimulated as planned, 4 times per year:

1/2S d/3 6d/7 ET 2.5% Pa 0.7(1) 4/y

5. Economic Study

This study uses the formulae set down in the publication by J.M. ESCHBACH, 1986, Weekly Tapping of Rubber Trees: Agronomical, Physiological and Economic Aspects, J. Nat. Rubb. Res. 1(4) 218.

Gross revenue/ha/year: $R = Y\ (1 - z)\ (P_1 - a) + z\ P_2 a$

Y = kg/ha/year
z = percentage of scrap
P_1 = price of latex P_2 = Price of scrap
a = incentive rate of latex

Exploitation cost : $C = W.N \frac{D}{T} + S$

W = daily wages (premiums, social charges, supervision)
N = annual number of tappings per hectare
D = density of tappable trees per hectare
S = stimulation cost per hectare per year
T = task (trees per tapper)

Profit : $B = R - C$

5.1. No tapper shortage

We assume that:

z = 0.3 for d/2 and z = 0.27 for d/3
P_1 = M$ 2 and P_2 = M$ 1.75

d/2 : $R_2 = (1.93 - 0.70\ a)$ d/3 : $R_3 = Y\ (1.93 - 0.73\ a)$

and that

N_2 = 150 for d/2 and N3 = 100 for d/3
D = 320 trees/ha
T = 500 trees/task
S = M$ 52 for 8 stimulations/year

d/2 : $C_2 = 96\ W$ d/3 : $C_3 = 64\ W + 52$

The other costs are fixed, or independent of the tapping frequency, as a first approximation.

The gains obtained in manpower with tapping in d/3 will therefore be:

$B_3 - B_2 = (R_3 - C_3) - (R_2 - C_2) = 32\ W - 0.03\ Ya - 52$

i.e. M$ 280/ha/year for a = 0.44 and W = 9

which, for 30,000 hectares tapped at FELCRA, means 6.6 million dollars per year.

Yield variations (Y) or production bonuses (a) have little effect on $B_3 - B_2$ (figures 5 and 6).

However, the difference is more sensitive to variations in W (figure 7).

For the same profit, tapping in d/3 would make it possible to increase tapper payment from M$ 9 to M$ 12.5/day.

5.2. With a shortage of tappers

With only 2/3 of the required tappers (100 tappings/ha/year) or 2/3 of tasks tapped, we have a production potential, Y, of:

$N_2 = 100$ when $Y_2 = Y \times \frac{100}{150}$ for d/2

$N_3 = 100$ when $Y_3 = Y$ for d/3

$R_2 = \frac{2\ Y}{3}\ (1.93 - 0.70\ a)$ $C_2 = 64\ W$

$R_3 = Y\ (1.93 - 0.73\ a)$ $C_3 = 64\ W + 52$

$B_3 - B_2 = Y\ (0.64 - 0.26\ a) - 52$

For Y = 1,250 kg the difference in profit amounts to around M$ 600/ha/year (Figure 8).

5.3. Wage Structure

In d/3, the tapper's production bonus is increased by 50% for 13 kg/tapping/day:

in d/2 : 13 x $ 0.44/kg x 25 days/month = $ 143/month
i.e. in d/3 : 143 x 1.5 = $ 215/month

The benefit derived from reducing tapping frequency should go some way towards introducing a tapping quality bonus.

In the most unfavourable hypothesis, where the number of tappers is not a limiting factor, income per hectare is higher by about $ 220/year for tapping in d/3, which corresponds to 220 x T/D x 1/N x 1/12 = $ 57/tapper/month.

The gain therefore applies both for the tapper ($ 72/month) and for FELCRA ($ 220/ha/year or $ 57/tapper/month).

One can therefore reasonably introduce a sufficiently incentive tapping quality bonus for tappers.

If the cost of such a bonus is covered equally by the additional income of both tappers and FELCRA, it could amount to (72 + 57)/2 = $ 65/month.

It is not unreasonable to vary the quality bonus from $ 0 to $ 100/month. This bonus could be calculated using the example in the IRCA technical data sheet, which has already been supplied to FELCRA.

Tableaux et Figures

Tableau No. 1

Characteristics of Demonstation Plots on Virgin Bark

N°	1	2	3	4	5
Scheme	BENDANG MAN	ULU ROKAN	ULU JENUT	BKT PEDOMAN 3	BKT PEDOMAN 1
State	KEDAH	NEGRI SEMBILAN	PAHANG	JOHOR	JOHOR
Soil	Rengam	Rasak	Batu Lapan	Kuala Brang	Kuala Brang
Rain mm	2159	1593	2017	2508	2508
days	83	146	140	181	181
Clone	PR 261 (35) PR 255 (35) GT 1 (30)	RR 600 (70) GT 1 (30)	RR 600 (50) GT 1 (45) Others (5)	RR 600 (50) GT 1 (45)	GT 1 (80) Others (20)
Planting	1983	1982	1984	1984	1977
Stand/ha	490	456	464	514	448
Opening	11/07/91	19/09/91	04/08/91	16/09/91	07/86
Starting	11/07/91	19/09/91	04/08/91	16/09/91	10/07/91
Pannel	A 1.4m	A	A 1.27 m	A	B
Stand/ha	348	428	420	260	282
Treatments					
d/2	1 green	1 green	1 green	1 green	1 green
d/3 4/y	2 black	2 black	2 black	2 black	
d/3 6/y	3 yellow	3 yellow	3 yellow	3 yellow	2 yellow
d/3 10/y					
d/4 6/y	4 red	4 red	4 red	4 red	
d/4 8/y					3 red

Tableau No. 2

Characteristics of Demonstation Plots on Renewed Bark

N°	6	7	8	9
Scheme	ULU PAUH	BKT TAMPOI 1	BKT TAMPOI 2	BKT KEREMOYANG
State	PERLIS	KEDAH	KEDAH	JOHOR
Soil	Jitra	Jitra	Jitra	Gajah Mati
Rain mm	1873	1923	1923	2184
days	126	113	113	157
Clone	RR 600 (70) GT 1 (15)	GT 1 (60) RR 600 (20)	GT 1 (100)	RR 600 (100)
Planting	1970	1972	1974	1973
Stand/ha	400	448	448	400
Opening	05/79	07/81	04/83	05/80
Starting	06/07/91	01/07/91	11/07/91	05/09/91
Pannel	C, D	C	B, C	C
Stand/ha		261		323
Treatments				
d/2	1 green	1 green	1 green	1 green
d/3 10/y	2 yellow	2 yellow	2 yellow	
d/4 10/y	3 red	3 red	3 red	2 red
1/4s d/3 10/y	4 blue	4 blue	4 blue	3 blue
1/4s d/4 12/y			5 black	4 black

Date of Stimulation
on Demonstration Plot

Tableau No. 3

Scheme	Treat.	Task	3	4	5	6	7	8	9	10	11	12	1	2
Bendang Man	2 black	4 5 12		x		x		x			x			
	3 yellow	3 8 9		x		x		x	x		x	x		
	4 red	2 6 11		x		x		x	x		x	x		
Ulu Rokan	2 black	2 6 10		x			x		x		x			
	3 yellow	3 7 11		x			x		x	x	x	x		
	4 red	4 8 12		x			x		x	x	x	x		
Ulu Jenut	2 black	4 8 10		x			x		x		x			
	3 yellow	1 7 12		x			x		x	x	x	x		
	4 red	2 6 11		x			x		x	x	x	x		
Bukit Pedoman 3	2 black	11 1 8		x		x		x		x				
	3 yellow	12 5 10		x		x		x	x	x			x	
	4 red	3 4 9		x		x		x	x	x			x	
Bukit Pedoman 1	2 yellow	5 8 11 3		x		x		x	x	x			x	
	3 red	1 6 9 10		x	x	x	x	x	x	x			x	
Ulu Pauh	2 yellow	144 60 148		x	x	x	x	x	x	x	x	x	x	
	3 red	58 146 63		x	x	x	x	x	x	x	x	x	x	
	4 blue	59 145 147		x	x	x	x	x	x	x	x	x	x	
Bukit Tampoi 1	2 yellow	8 4 10		x	x	x	x	x	x	x	x	x	x	
	3 red	7 2 12		x	x	x	x	x	x	x	x	x	x	
	4 blue	6 3 11		x	x	x	x	x	x	x	x	x	x	
Bukit Tampoi 2	2 yellow	11 10 4		x	x	x	x	x	x	x	x	x	x	
	3 red	8 13 3		x	x	x	x	x	x	x	x	x	x	
	4 blue	7 14 9		x	x	x	x	x	x	x	x	x	x	
	5 black	2 15 5		x	x	x	x	x	x	x	x	x	x	
Bukit Keremoyiang	2 red	59 52 56		x	x	x	x	x	x	x	x	x	x	
	3 blue	55 54 60		x	x	x	x	x	x	x	x	x	x	
	4 black	51 49 58		x	x	x	x	x	x	x	x	x	x	

Tableau No. 4

Characteristics of new pilot plantations

State	SCHEME	Ha	Planting Opening Pannel	Clone	S.P.H. Total Tapped	Tasks Tappers	Soil	Propos.	Tappe	Task
Perlis	ULU PAUH	360	1970 1979 C, D	RR 600 100%	278 238	187 75	Jitra	d/3 d/2 trial	30 42 5	90 84 12
Kedah	PULAU BELANTIK I	436	1976 1985 B	GT 1 80% PR 261 20%	330 314	270 135	Durian Muchong	d/3	90	270
Kedah	KAMPONG KOK	107	1981 1988 B	GT 1 40% PR 261 40% PR 255 20%	460 416	81 27		d/3	27	81
Pahang	PESAGI I, II, III	1025	1983-87 1992 A	GT 1 30-40% RR 600 50% Others 10-20%	495	291 146	Alluvium deposit	I d/4 II d/3 III d/2	28 44 25	111 130 50
Pahang	BATU EMPAT	369	1970 1978 C D		205	147 40	Durian Muchong	d/4	40	120
Pahang	PAYA LUAS	213	1971-72 1979 C D		235	104	Rasau	d/3 1/4S d/4	28 5	84 20
Negeri Sembilan	ULU YOH	220	1983 1992 A	GT 1 30% RR 600 60% Others 10%		180 60		d/3	60	180
Negeri Sembilan	KAMPUNG AWAT	348	1980 5/90 A	GT 1 25% RR 600 60% PR 261 15%	378 297	180 95	Alluvium Durian Gajah Mati	d/2 d/3	36 36	72 108
Johor	TEBING TINGGI I, II, V	1092	1977-81 1986-89 A B	GT 1 40-75% RR 600 20% PR 261 20%	345 273	480	Durian Gajah Mati	I d/4 II d/3 V d/3	52 47 44	208 140 132
Johor	MAWAI BARU	236	1974 1981 C D	RR 600 95% GT 1 5%	309	146 60	Rengam	d/3 1/4S d/4	42 5	126 20
Johor	BUKIT PEDOMAN III	268	1984 1992 A	RR 600 50% GT 1 45% Others 5%	514 260	140	Kuala Brang Pohoi Kuah	d/3 trial	43 5	128 12
Total		4674							734	2178

Date of stimulation
on new pilot plantations

Tableau No. 5

Plantation	Stim/year	3	4	5	6	7	8	9	10	11	12	1
ULU YOH	4		1			1		1		1		
KAMPONG KOK	6	15	15		1		1		15	15		
PESAGI	6		1	15		1	15		1	15		
KAMPUNG AWAT	6		1	15		1	15		1	15		
TEBING TINGGI	6		1	15		1	15		1	15		
PULAU BELANTIK	8		1	15		1	1	1	1	1	1	
ULU PAUH	8	15		1	15	15	15	15	15	15		
BATU EMPAT	10		1	1	1	1	1	1	1	1	1	1
PAYA LUAS	10		1	1	1	1	1	1	1	1	1	1
MAWAI BARU	10		1	1	1	1	1	1	1	1	1	1

Figure No. 1

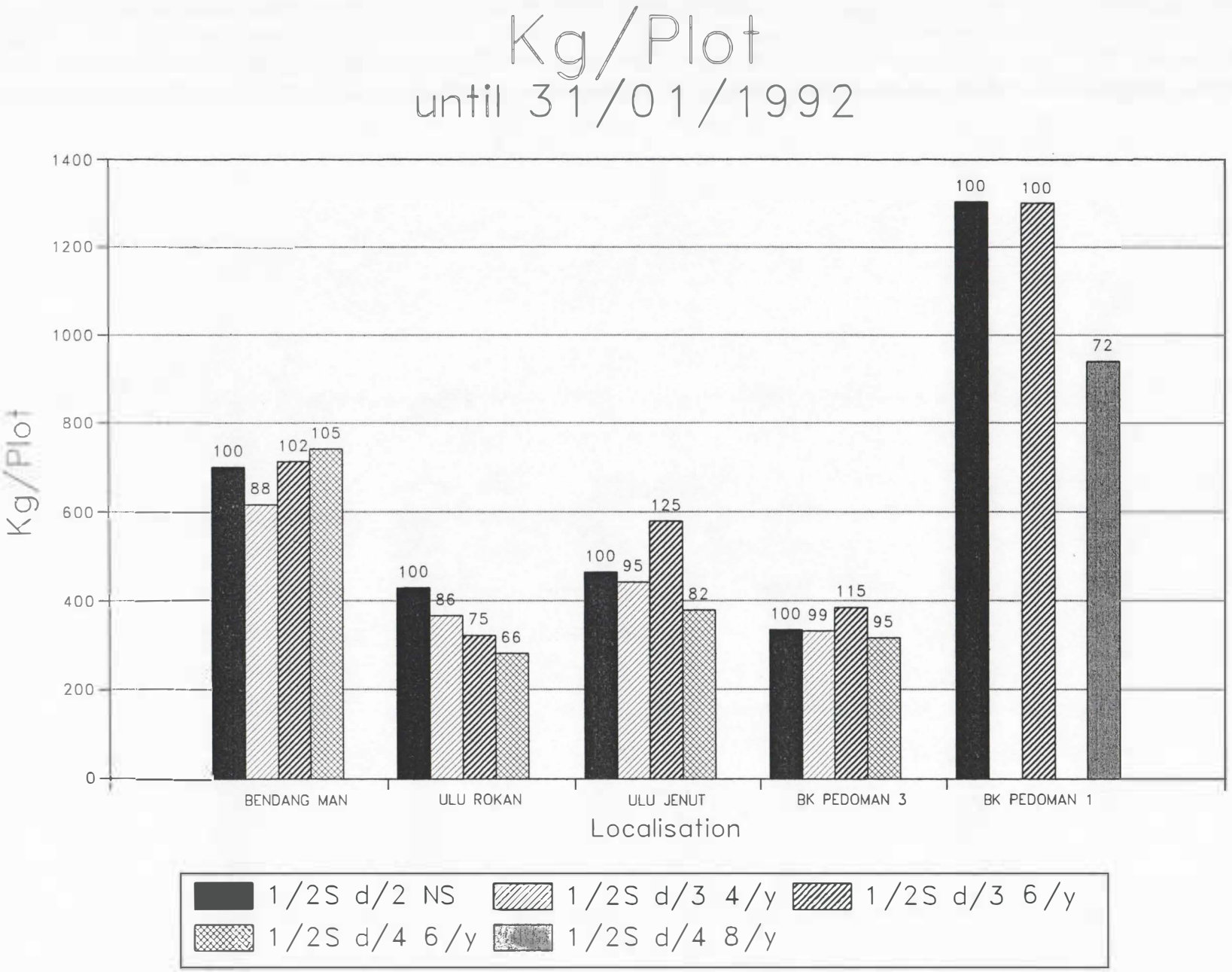
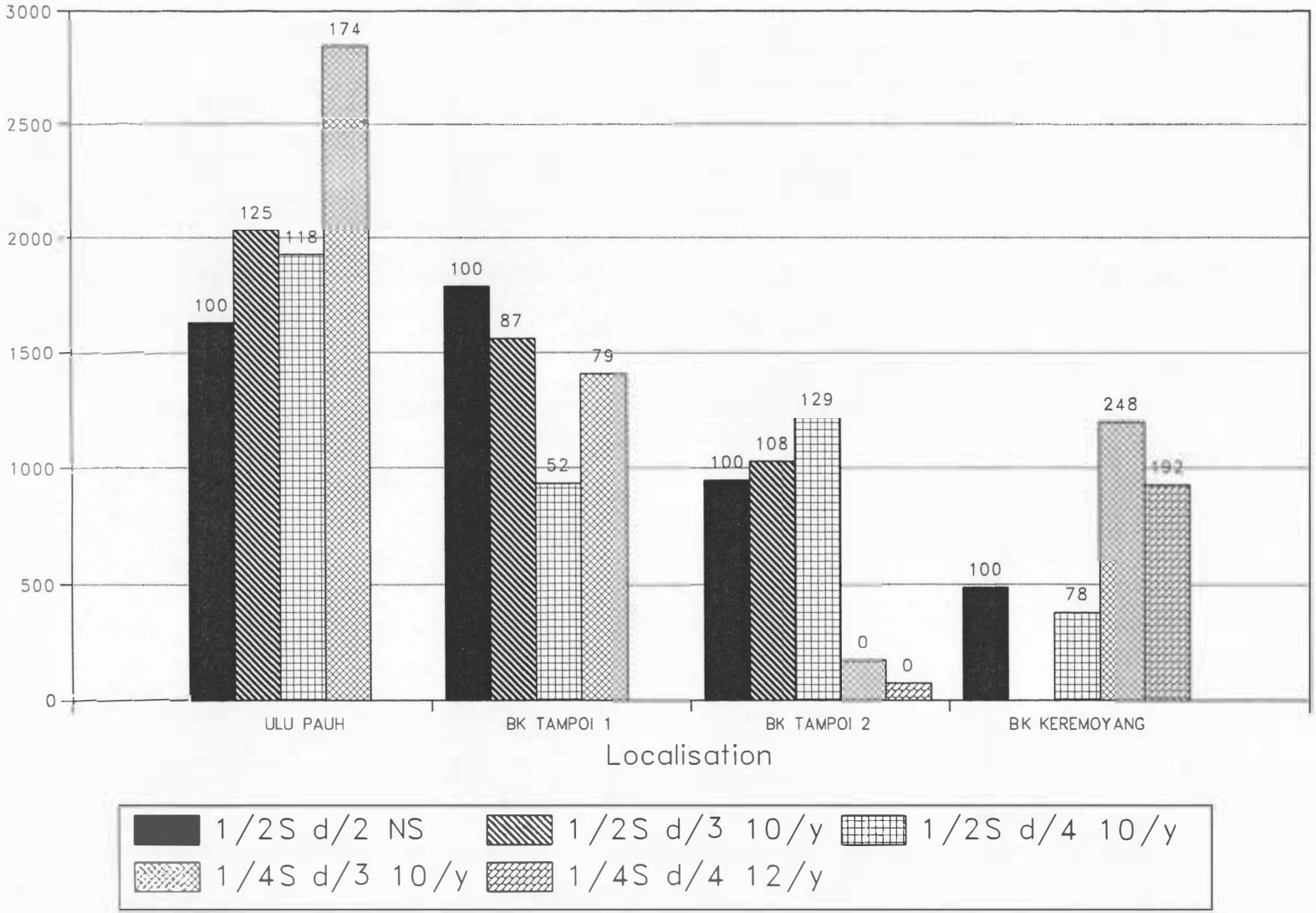

Kg/Plot
until 31/01/1992
Kg/Plot
1400
1200
1000
800
600
400
200
0
100
88
102
105
100
86
75
66
100
95
125
82
100
99
115
95
100
100
72
BENDANG MAN
ULU ROKAN
ULU JENUT
BK PEDOMAN 3
BK PEDOMAN 1
Localisation
1/2S d/2 NS
1/2S d/3 4/y
1/2S d/3 6/y
1/2S d/4 6/y
1/2S d/4 8/y

Figure No. 2

Kg/Plot
until 31/01/1992



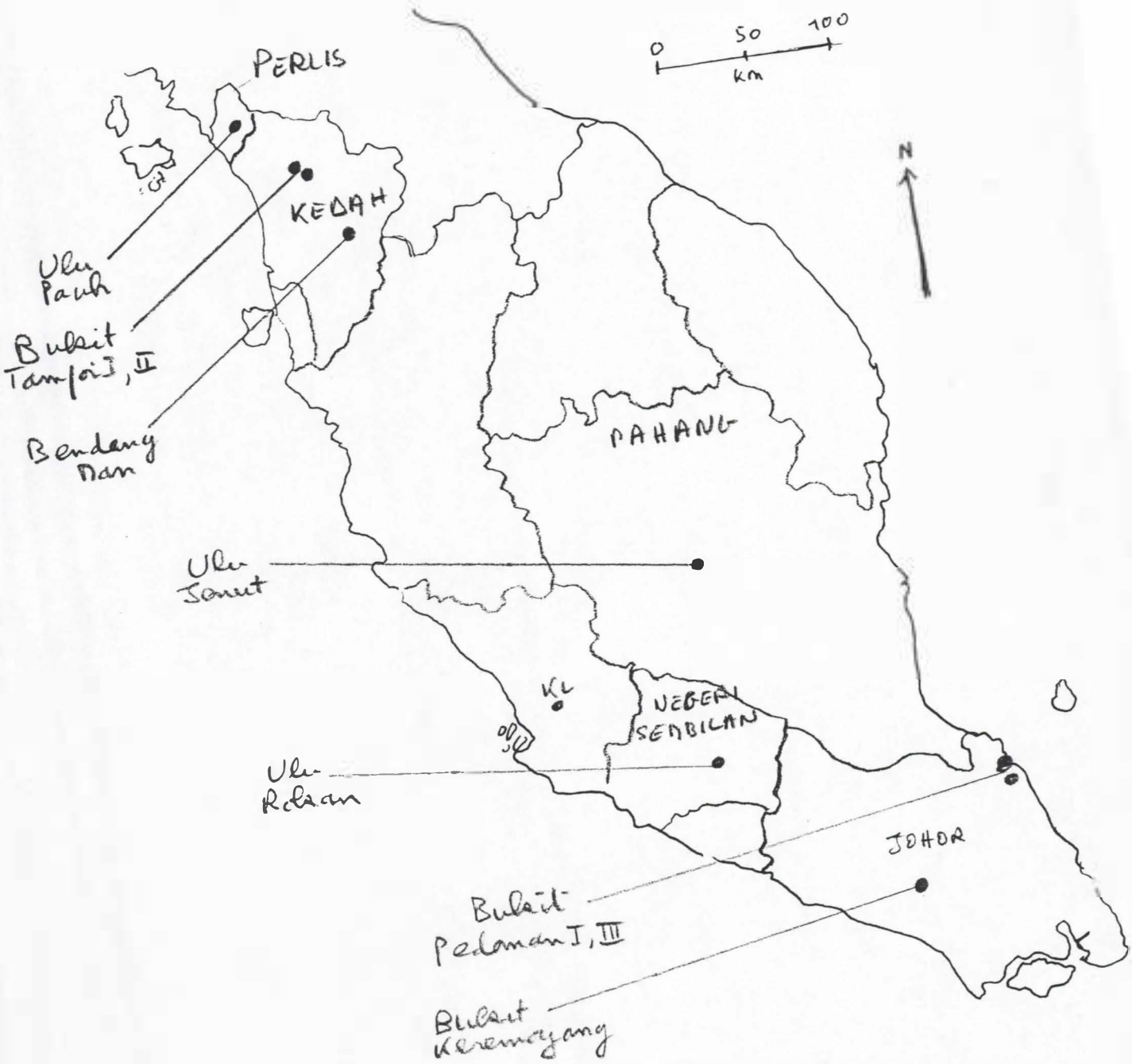


Figure No. 3 : Localisation of demonstration plots

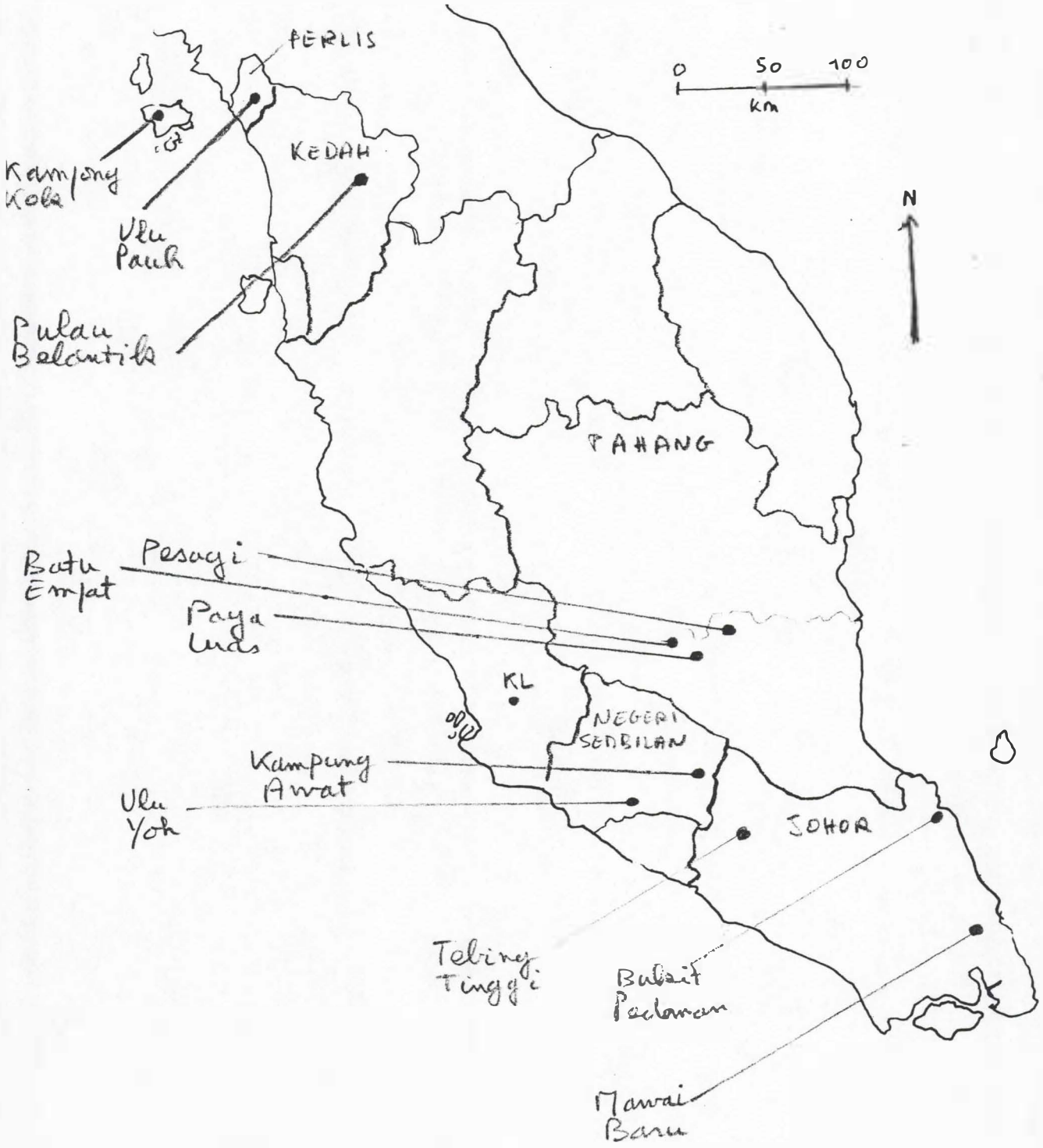


Figure No. 4 : Localisation of pilot plantations

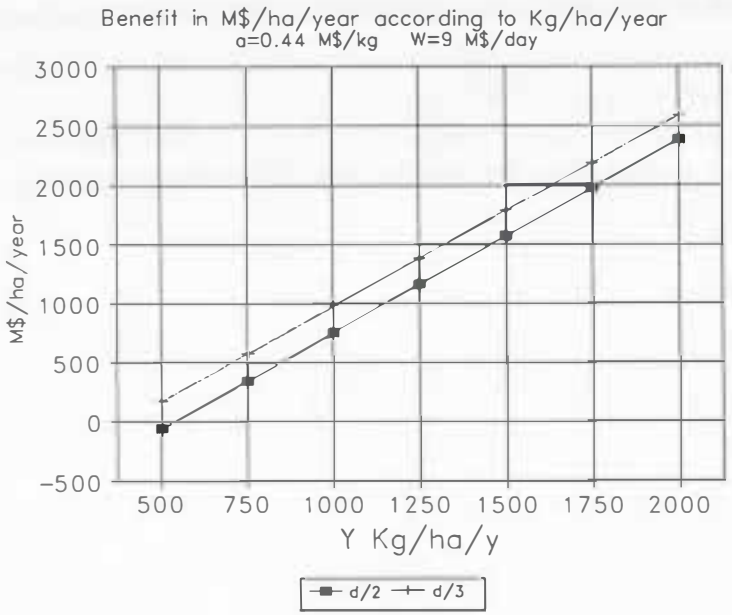


Figure No. 5

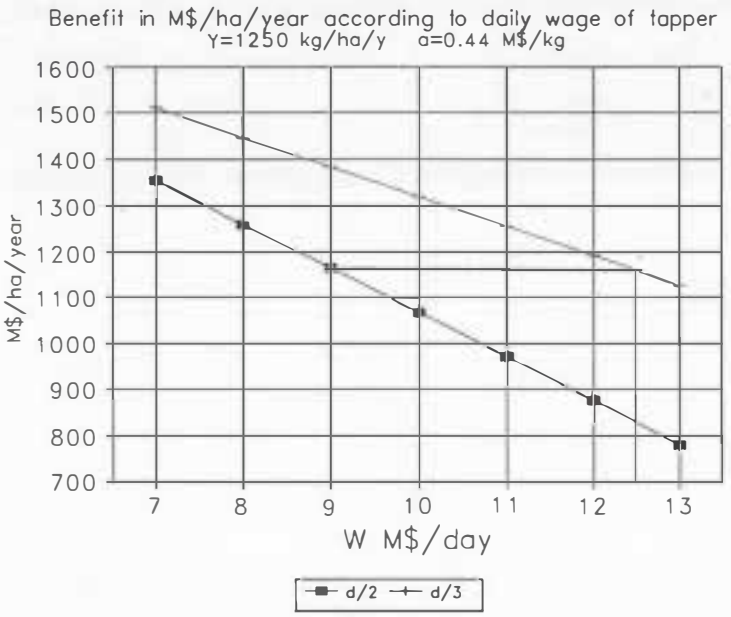


Figure No. 7

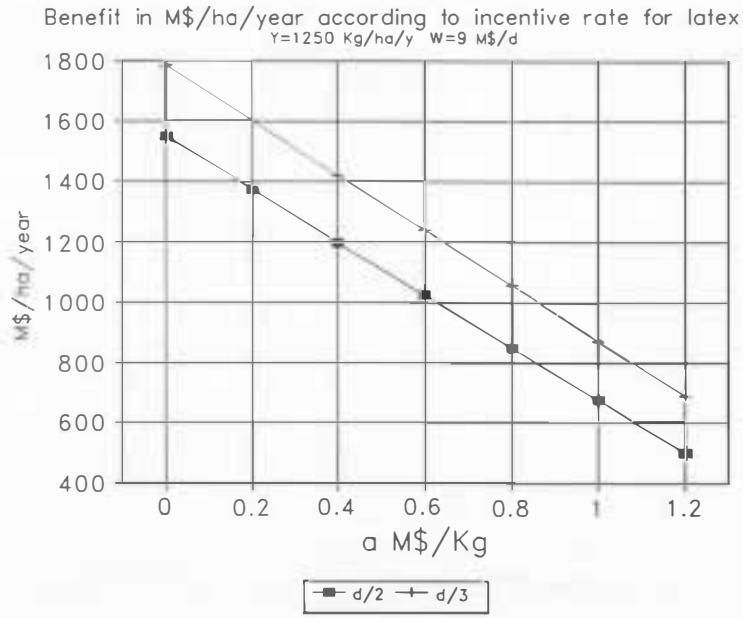


Figure No. 6

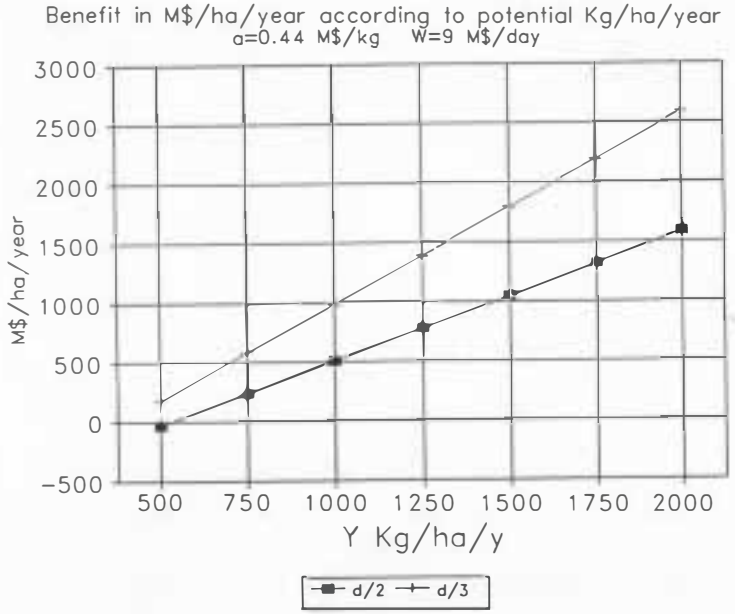


Figure No. 8

Annexes

U

Titre de l'essai

Reduced Frequency Tapping on BENDANG MAN

	Noms des Traitements
1	d/2 NS
2	d/3 4/y
3	d/3 6/y
4	d/4 6/y

CUMUL KG SEC / PARCELLE	1bendang	31/ 8/1991	31/ 1/1992

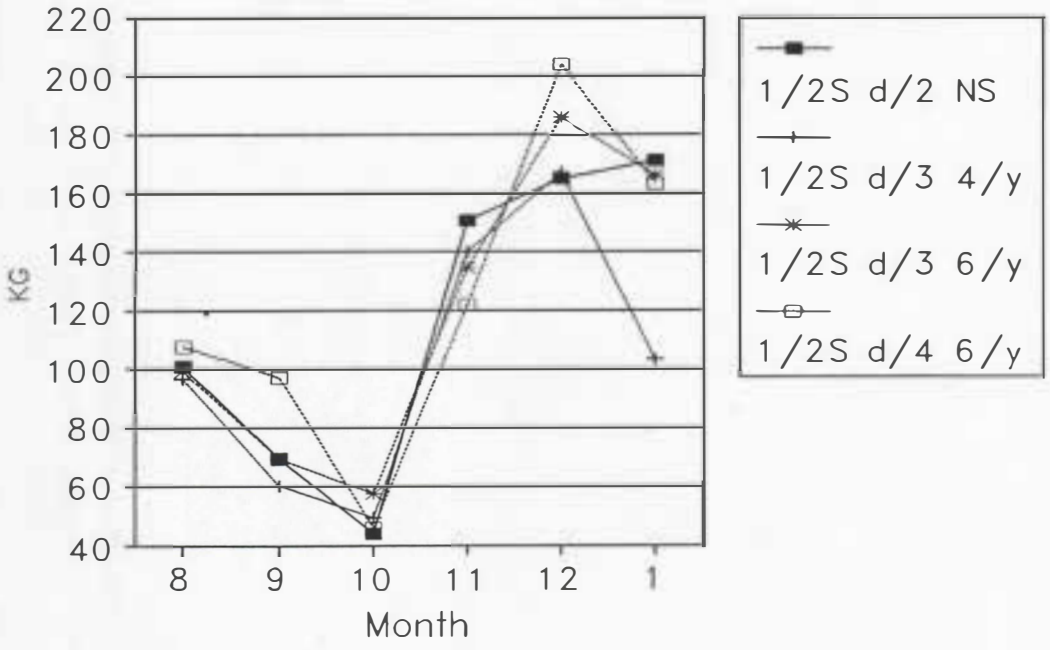
Trait	Rep. 1	2	3	moy.
1	725.60	781.20	596.50	701.10
2	583.00	760.40	505.40	616.27
3	731.70	693.20	712.50	712.47
4	773.90	814.60	630.50	739.67
moy.	703.55	762.35	611.22	692.37

CUMUL NOMBRE DE SAIGNEE	1bendang	31/ 8/1991	31/ 1/1992

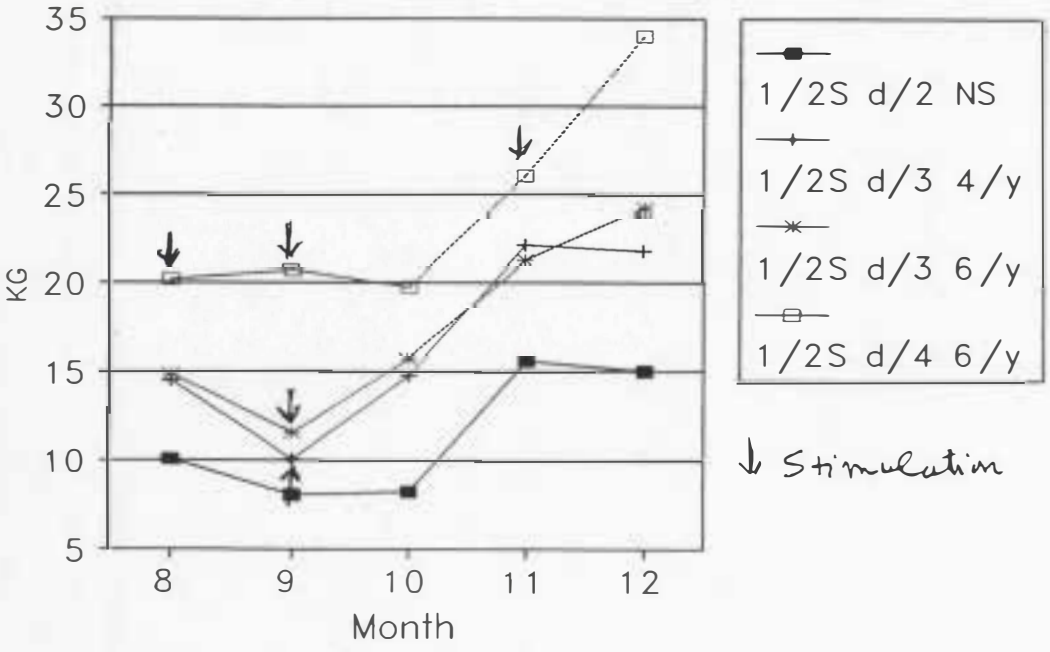
Trait	Rep. 1	2	3	moy.
1	58.00	59.00	57.00	58.00
2	39.00	38.00	39.00	38.67
3	39.00	38.00	40.00	39.00
4	30.00	31.00	28.00	29.67
moy.	41.50	41.50	41.00	41.33

BENDANG MAN

Kg/Plot



Kg/Tapper/Day



↓ Stimulation

U

Titre de l'essai

Reduced Frequency Tapping on ULU ROKAN

Noms des Traitements	
1	d/2 NS
2	d/3 4/y
3	d/3 6/y
4	d/4 6/y

ANALYSE DE VARIANCE

	DDL	CARRES MOYENS	TEST F	PROBA	E.T.	C.V.
VAR.TOTALE	11	5287.81				
VAR.FACTEUR 1	3	12093.33	5.17	0.0427		
VAR.BLOCS	2	3656.08	1.56	0.2842		
VAR.RESIDUELLE 1	6	2337.42			48.35	13.8%

CUMUL KG SEC / PARCELLE	2ulurok	31/10/1991	31/ 1/1992

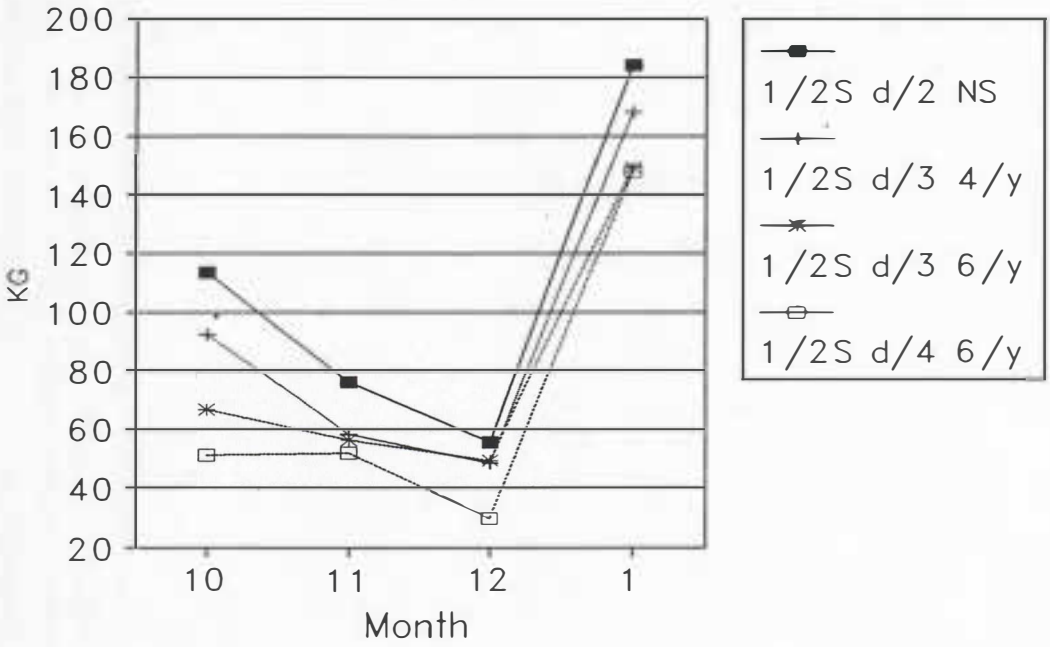
Trait	Rep. 1	2	3	moy.
1	500.20	395.60	391.30	429.03
2	434.20	330.40	336.50	367.03
3	335.50	346.60	283.00	321.70
4	266.60	240.60	335.10	280.77
moy.	384.12	328.30	336.47	349.63

FI	LIBELLES	MOYENNES	GROUPES HOMOGENES
1	1	429.00	A
2	2	367.00	AB
3	3	321.67	AB
4	4	281.00	B

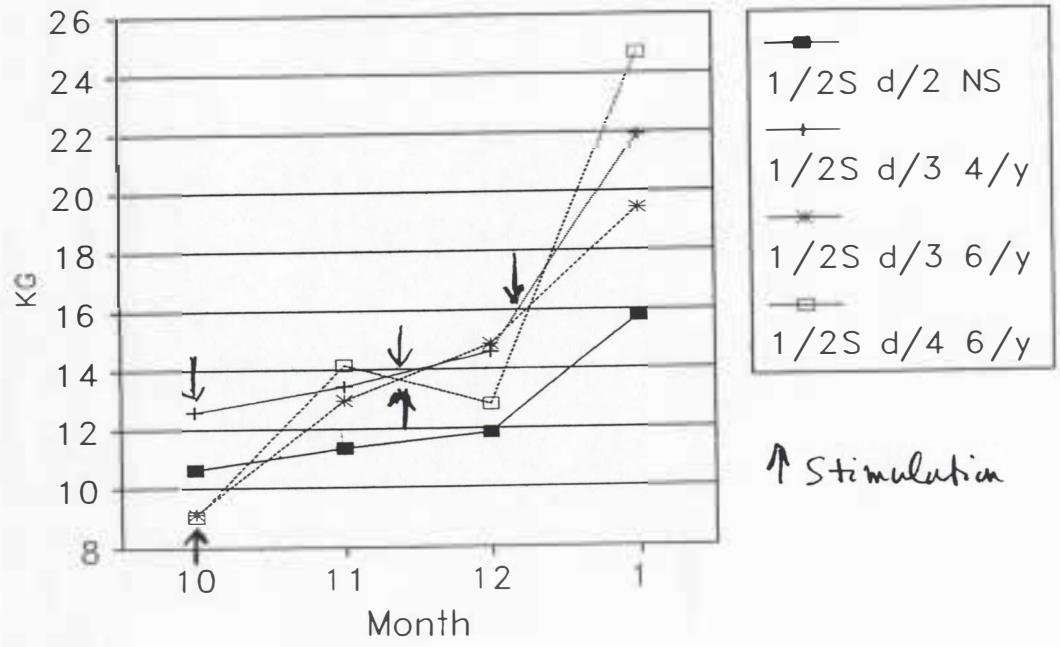
CUMUL NOMBRE DE SAIGNEE	2ulurok	31/10/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	34.00	33.00	34.00	33.67
2	23.00	24.00	21.00	22.67
3	23.00	24.00	21.00	22.67
4	17.00	19.00	17.00	17.67
moy.	24.25	25.00	23.25	24.17

ULU ROKAN
Kg/Plot



Kg/Tapper/Day



↑ Stimulation

U

Titre de l'essai

Reduced Frequency Tapping on ULU JENUT

	Noms des Traitements
1	d/2 NS
2	d/3 4/y
3	d/3 6/y
4	d/4 6/y

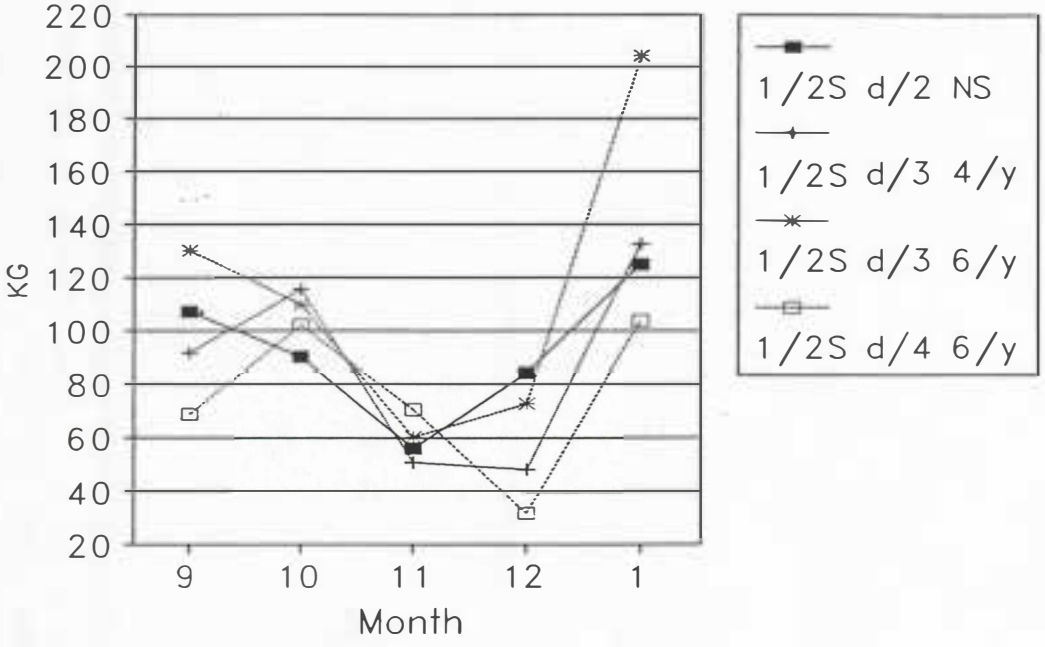
CUMUL KG SEC / PARCELLE	3ulujen	30/ 9/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	469.20	486.80	429.80	461.93
2	359.40	403.70	559.30	440.80
3	535.50	428.60	766.30	576.80
4	450.90	309.90	371.70	377.50
moy.	453.75	407.25	531.77	464.26

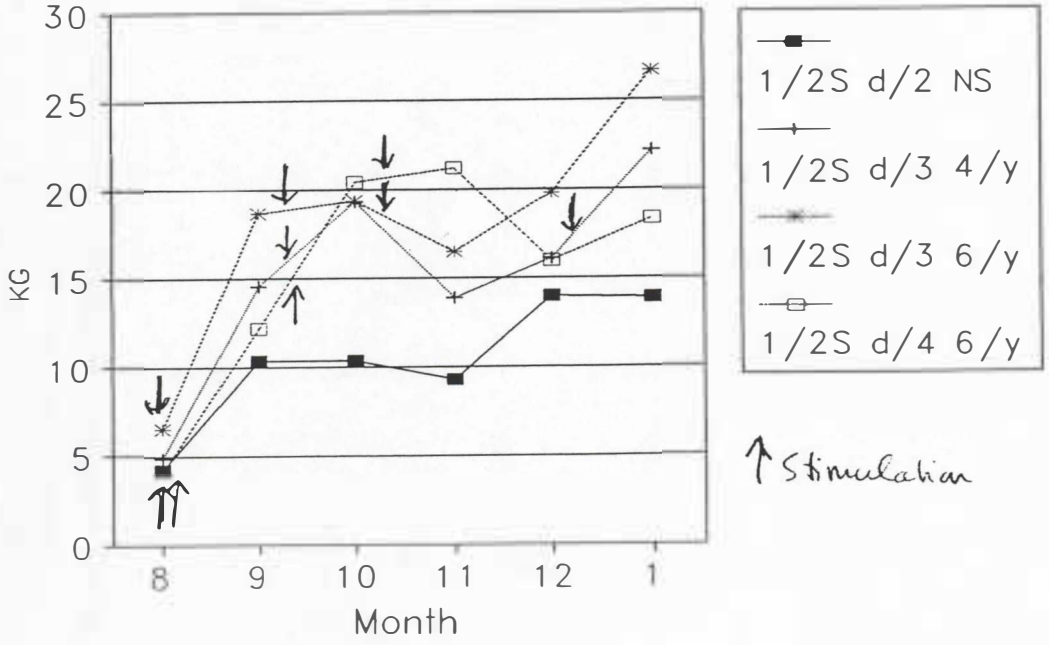
CUMUL NOMBRE DE SAIGNEE	3ulujen	30/ 9/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	44.00	42.00	34.00	40.00
2	23.00	25.00	27.00	25.00
3	29.00	23.00	31.00	27.67
4	21.00	23.00	21.00	21.67
moy.	29.25	28.25	28.25	28.58

ULU JENUT
Kg/Plot



Kg/Tapper/Day



U

Titre de l'essai

Reduced Frequency Tapping on BUKIT PEDOMAN III

Noms des Traitements	
1	d/2 NS
2	d/3 4/y
3	d/3 6/y
4	d/4 6/y

CUMUL KG SEC / PARCELLE	4BKPEDO3	30/ 9/1991	31/ 1/1992

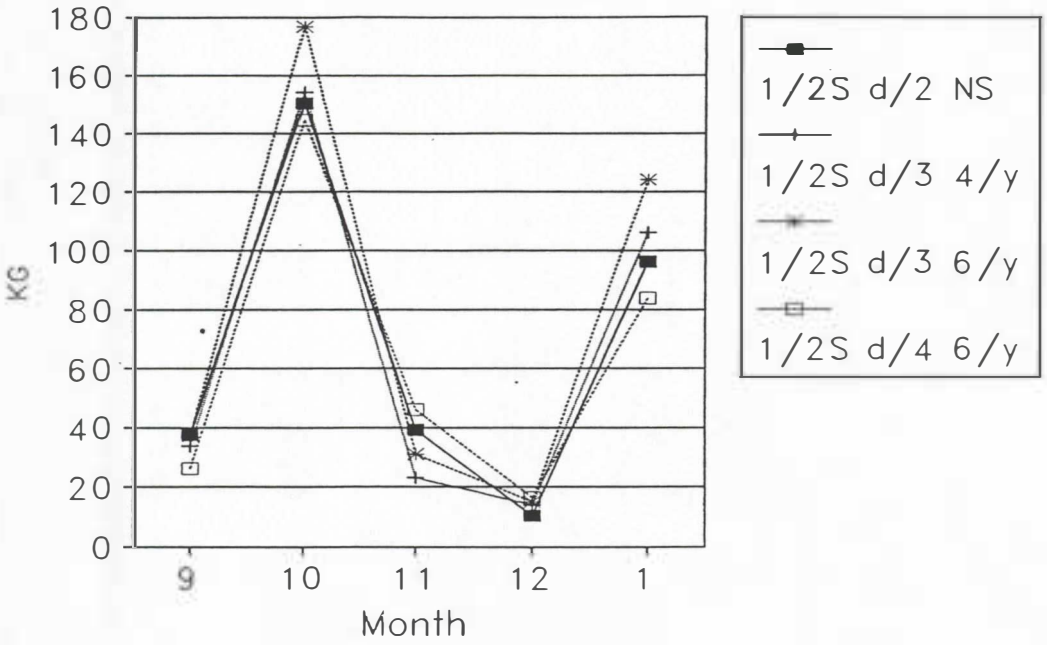
Trait	Rep. 1	2	3	moy.
1	336.80	304.30	361.70	334.27
2	306.70	401.60	284.70	331.00
3	398.30	338.60	417.50	384.80
4	228.80	383.50	342.70	318.33
moy.	317.65	357.00	351.65	342.10

CUMUL NOMBRE DE SAIGNEE	4BKPEDO3	30/ 9/1991	31/ 1/1992

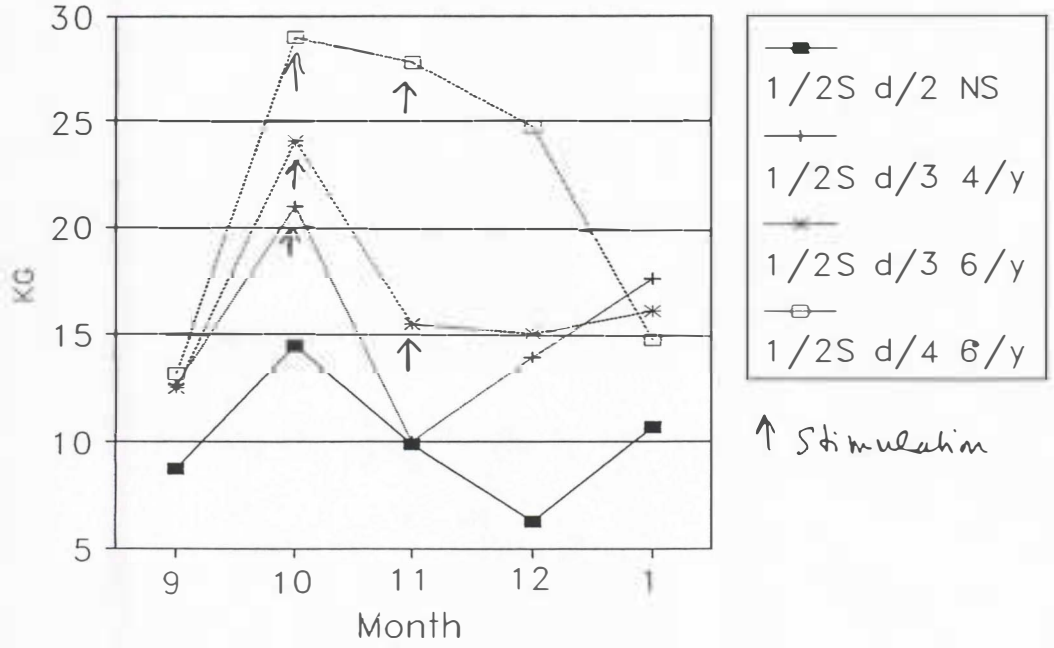
Trait	Rep. 1	2	3	moy.
1	29.00	29.00	29.00	29.00
2	19.00	21.00	17.00	19.00
3	21.00	16.00	21.00	19.33
4	11.00	15.00	15.00	13.67
moy.	20.00	20.25	20.50	20.25

BK PEDOMAN 3

Kg/Plot



Kg/Tapper/Day



↑ Stimulation

J

Titre de l'essai

Reduced Frequency Tapping on BUKIT PEDOMAN I

Noms des Traitements	
1	d/2 NS
2	d/3 6/Y
3	d/4 8/y

ANALYSE DE VARIANCE

	DDL	CARRES MOYENS	TEST F	PROBA	E.T.	C.V.
VAR.TOTALE	11	68317.53				
VAR.FACTEUR 1	2	172322.56	4.19	0.0725		
VAR.BLOCS	3	53357.63	1.30	0.3588		
VAR.RESIDUELLE 1	6	41129.14			202.80	17.2%

CUMUL KG SEC / PARCELLE	5BKPEDO1	31/ 7/1991	31/ 1/1992

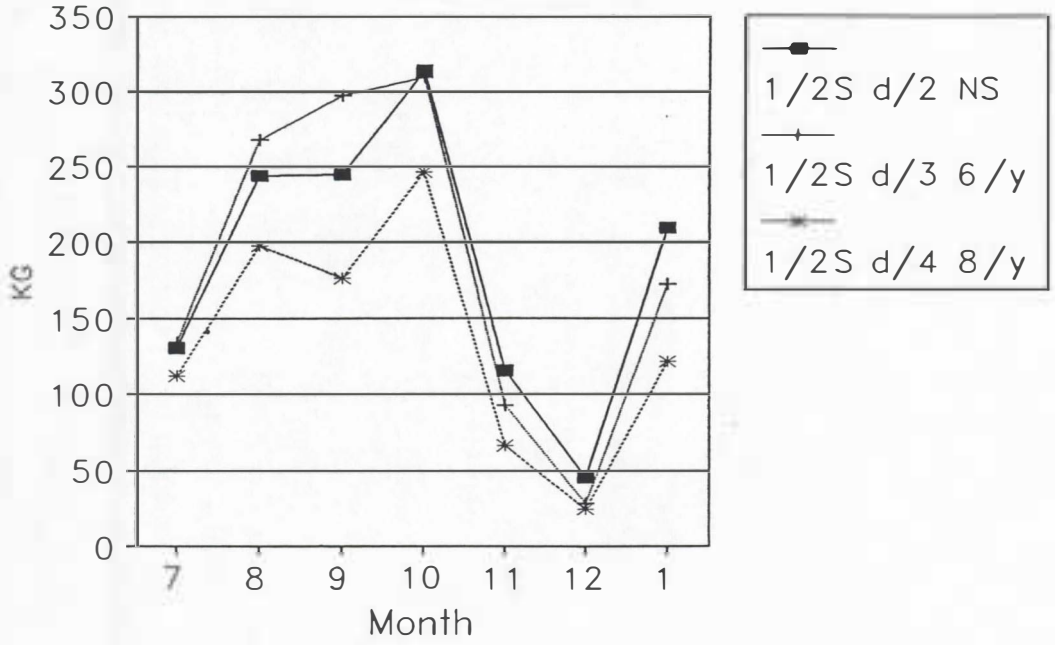
Trait	Rep. 1	2	3	4	moy.
1	1387.6	1565.9	1059.4	1192.6	1301.4
2	1149.9	1581.4	1473.1	996.00	1300.1
3	1099.5	874.90	918.90	870.80	941.02
moy.	1212.3	1340.7	1150.5	1019.8	1180.8

CUMUL NOMBRE DE SAIGNEE	5BKPEDO1	31/ 7/1991	31/ 1/1992

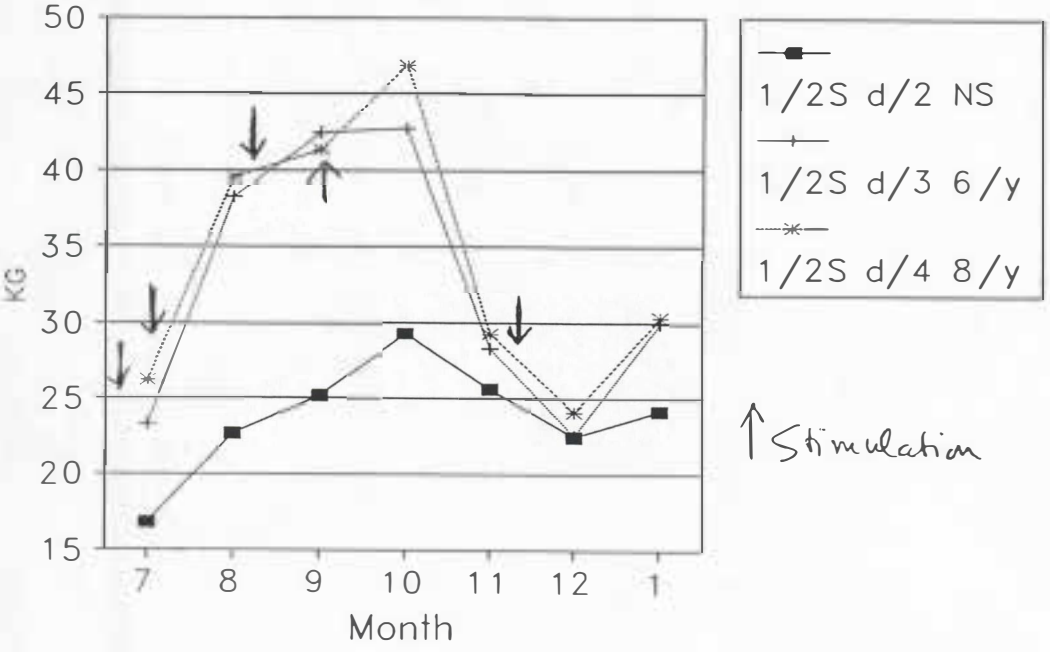
Trait	Rep. 1	2	3	4	moy.
1	52.00	55.00	53.00	54.00	53.50
2	33.00	39.00	36.00	41.00	37.25
3	28.00	25.00	25.00	26.00	26.00
moy.	37.67	39.67	38.00	40.33	38.92

BK PEDOMAN 1

Kg/Plot



Kg/Tapper/Day



↑ Stimulation

U

Titre de l'essai

Reduced Frequency Tapping on ULU PAUH

Noms des Traitements	
1	d/2 NS
2	d/3 10/y
3	d/4 10/y
4	1/4S UP d/3 10/y

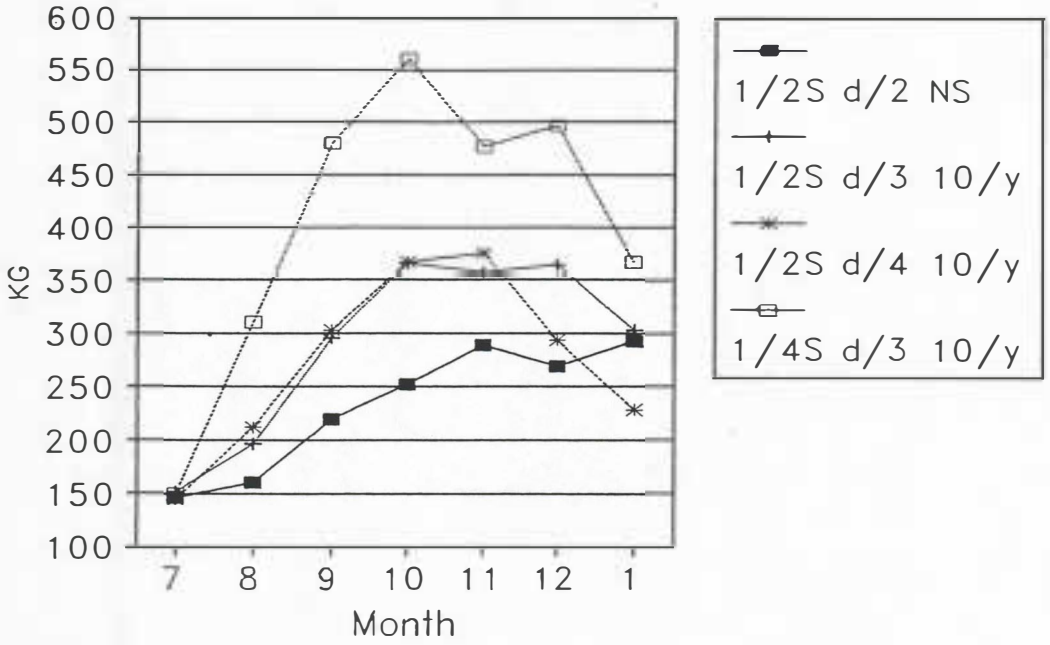
CUMUL KG SEC / PARCELLE	6ULUPAUH	31/ 7/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	1603.2	1713.2	1571.8	1629.4
2	1951.2	2076.9	2078.9	2035.7
3	2027.5	1892.2	1855.4	1925.0
4	2708.9	2861.6	2952.6	2841.0
moy.	2072.7	2136.0	2114.7	2107.8

CUMUL NOMBRE DE SAIGNEE	6ULUPAUH	31/ 7/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	69.00	72.00	69.00	70.00
2	48.00	48.00	45.00	47.00
3	35.00	32.00	34.00	33.67
4	48.00	48.00	45.00	47.00
moy.	50.00	50.00	48.25	49.42

ULU PAUH
Kg/Plot



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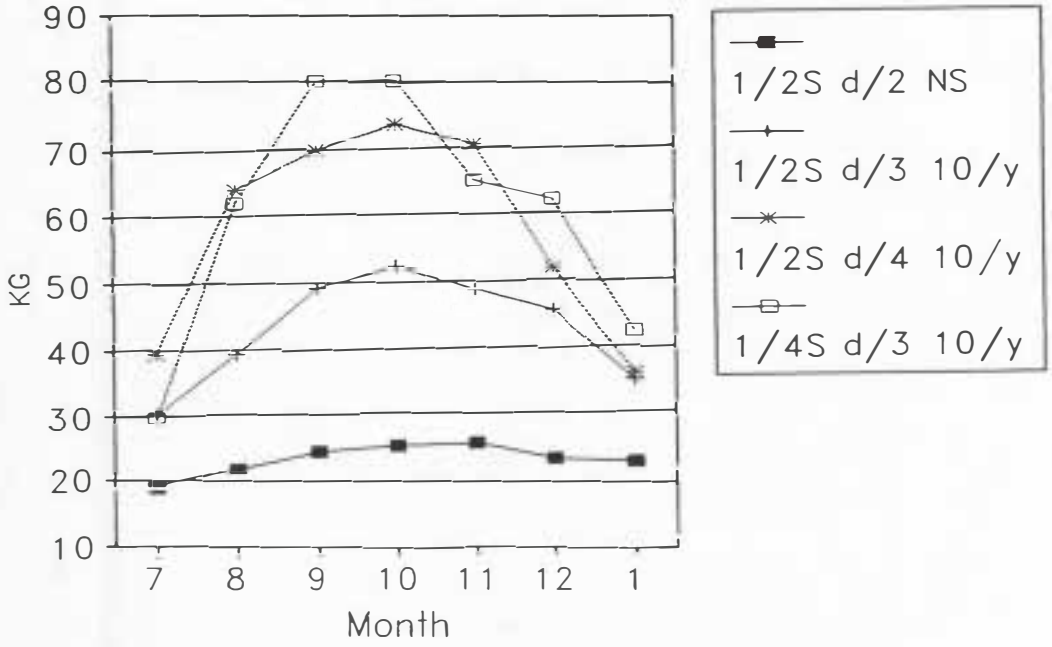


Titre de l'essai

:educed frequency tapping on BUKIT TAMPOI 1

	Noms des Traitements
1	d/2 NS
2	d/3 10/y
3	d/4 10/y
4	1/4S up d/3 10/y

ANALYSE DE VARIANCE

	DDL	CARRES MOYENS	TEST F	PROBA	E.T.	C.V.
VAR.TOTALE	11	68351.70				
VAR.FACTEUR 1	3	233996.20	39.76	0.0004		
VAR.BLOCS	2	7294.06	1.24	0.3552		
VAR.RESIDUELLE 1	6	5881.98			76.69	7.1%

CUMUL KG SEC / PARCELLE	7buktam1	31/ 8/1991	31/12/1991

Trait	Rep. 1	2	3	moy.
1	1265.0	1337.4	1371.9	1324.8
2	1316.5	1147.7	1173.7	1212.6
3	791.00	678.30	583.90	684.40
4	1120.3	1015.1	1091.2	1075.5
moy.	1123.2	1044.6	1055.2	1074.3

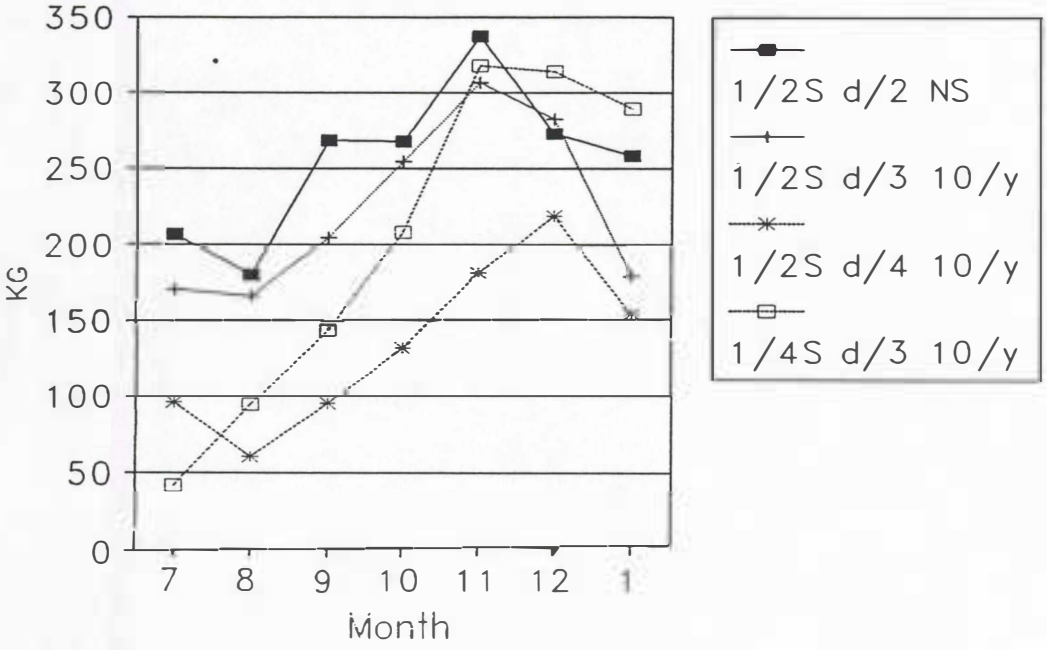
F1	LIBELLES	MOYENNES	GROUPES	HOMOGENES
1	1	1324.67	A	
2	2	1213.00	AB	
4	4	1075.33	B	
3	3	684.33	C	

CUMUL NOMBRE DE SAIGNEE	7buktam1	31/ 8/1991	31/12/1991

Trait	Rep. 1	2	3	moy.
1	47.00	49.00	47.00	47.67
2	32.00	30.00	33.00	31.67
3	27.00	24.00	18.00	23.00
4	32.00	30.00	33.00	31.67
moy.	34.50	33.25	32.75	33.50

BK TAMPOI 1

Kg/Plot



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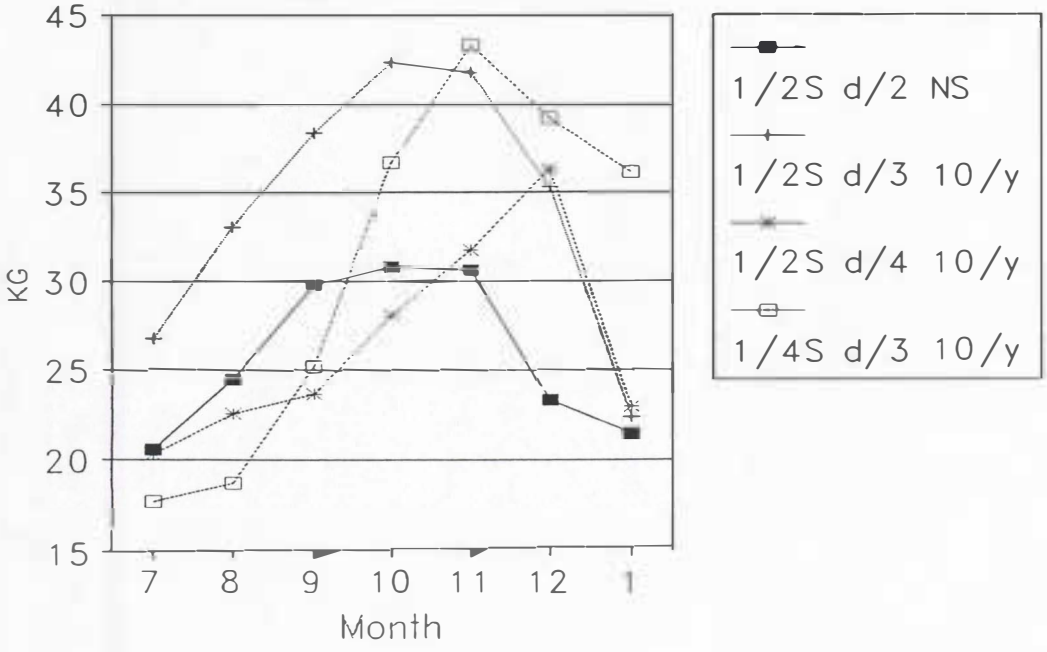


Titre de l'essai

Reduced Frequency Tapping on BUKIT TAMPOI II

	Noms des Traitements
1	d/2 NS
2	d/3 10/y
3	d/4 10/y
4	1/4S UP d/3 10/y
5	1/4S UP d/4 12/y

ANALYSE DE VARIANCE

	DDL	CARRES MOYENS	TEST F	PROBA	E.T.	C.V.
VAR.TOTALE	14	183925.27				
VAR.FACTEUR 1	4	628391.13	144.76	0.0000		
VAR.BLOCS	2	13328.88	3.07	0.1017		
VAR.RESIDUELLE 1	8	4341.44			65.89	11.6%

CUMUL KG SEC / PARCELLE	8BUKTAM2	31/ 7/1991	31/12/1991

Trait	Rep. 1	2	3	moy.
1	666.20	788.90	918.30	791.13
2	783.70	815.50	978.10	859.10
3	997.60	1011.8	1093.4	1034.3
4	151.90	86.10	101.60	113.20
5	39.00	41.40	37.40	39.27
moy.	527.68	548.74	625.76	567.39

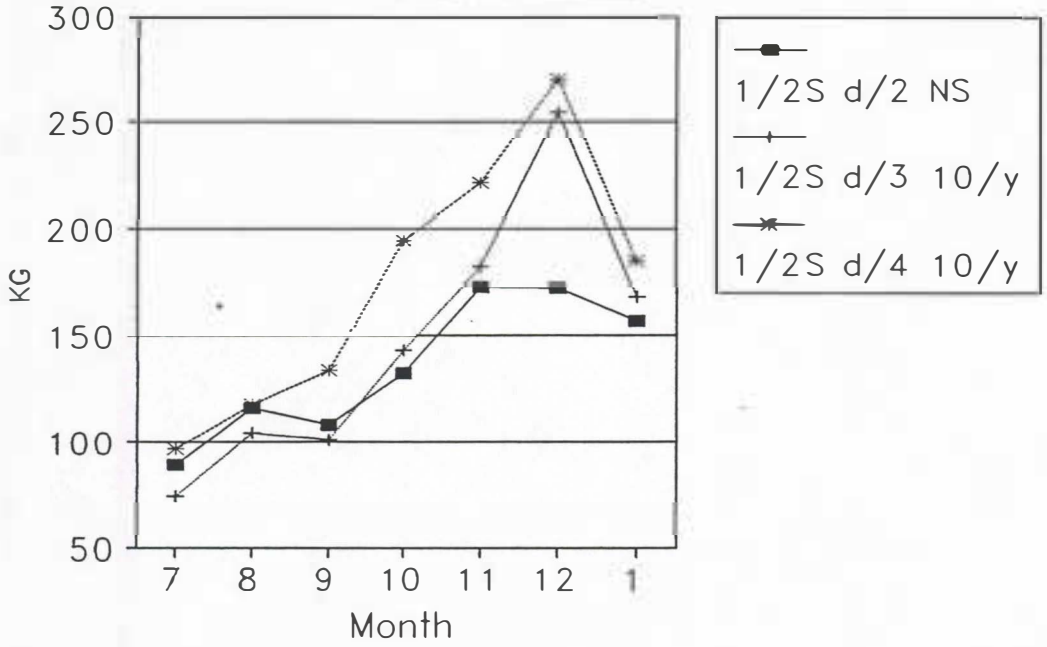
F1	LIBELLES	MOYENNES	GROUPES HOMOGENES
3	3	1034.33	A
2	2	858.00	B
1	1	791.00	B
4	4	113.33	C
5	5	39.00	C

CUMUL NOMBRE DE SAIGNEE	8BUKTAM2	31/ 7/1991	31/12/1991

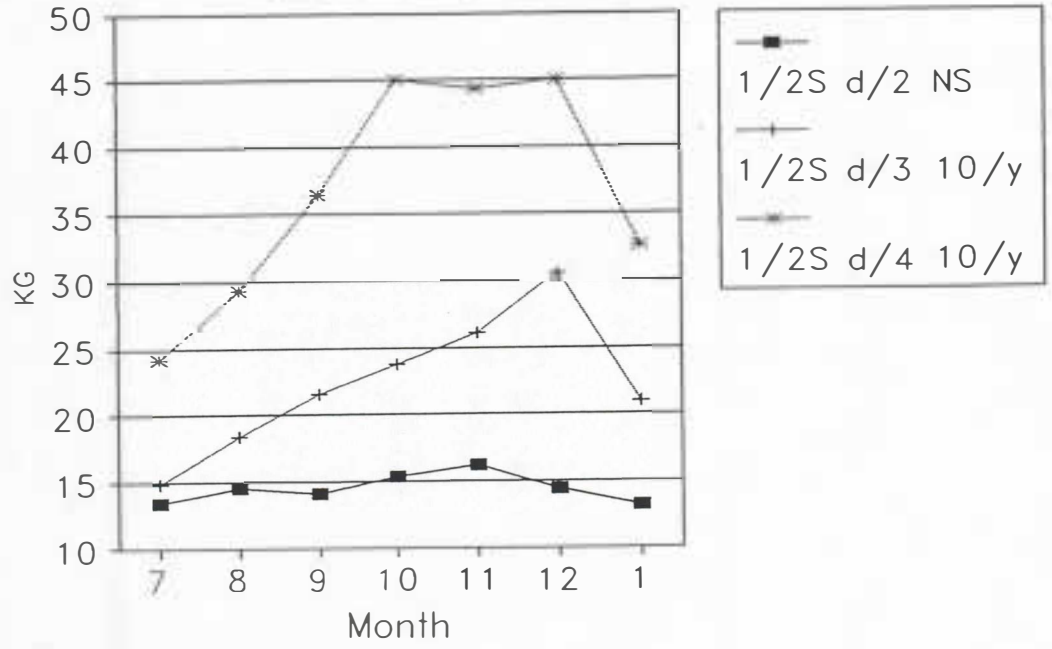
Trait	Rep. 1	2	3	moy.
1	53.00	57.00	51.00	53.67
2	35.00	35.00	40.00	36.67
3	24.00	28.00	29.00	27.00
4	7.00	5.00	6.00	6.00
5	4.00	3.00	3.00	3.33
moy.	24.60	25.60	25.80	25.33

BK TAMPOI 2

Kg/Plot



Kg/Tapper/Day



Titre de l'essai

Reduced Frequency Tapping on BUKIT KEREMOIYANG

	Noms des Traitements
1	d/2 NS
2	d/4 10/y
3	1/4S UP d/3 10/y
4	1/4S UP d/4 12/y

CUMUL KG SEC / PARCELLE	9BUKEREM	30/ 9/1991	31/ 1/1992

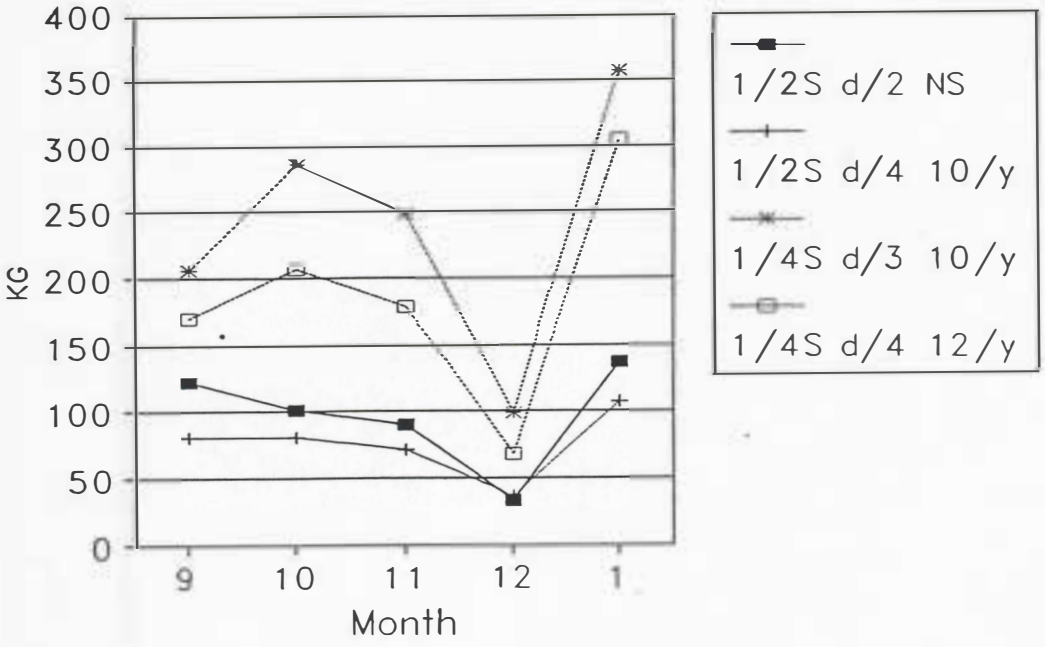
Trait	Rep. 1	2	3	moy.
1	410.70	384.70	654.70	483.37
2	339.00	425.70	359.20	374.63
3	958.80	1169.0	1463.2	1197.0
4	878.40	1027.2	877.20	927.60
moy.	646.72	751.65	838.57	745.65

CUMUL NOMBRE DE SAIGNEE	9BUKEREM	30/ 9/1991	31/ 1/1992

Trait	Rep. 1	2	3	moy.
1	37.00	39.00	41.00	39.00
2	21.00	22.00	23.00	22.00
3	26.00	28.00	33.00	29.00
4	20.00	23.00	23.00	22.00
moy.	26.00	28.00	30.00	28.00

BK KEREMOYANG

Kg/Plot



Kg/Tapper/Day